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University Examinations 2024/2025

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE AND BACHELOR OF SCIENCE (CHEMISTRY)

SCH 3400: ORGANOMETALLIC CHEMISTRY

DATE: JANUARY 2025

TIME: 2 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

QUESTION ONE (30 MARKS)

- a) In an extraction of iron, calcium oxide reacts with non-metallic oxide such as silica according to the following chemical equation $\text{CaO(s)} + \text{Al}_2\text{O}_3\text{(g)} \rightarrow \text{Ca(AlO}_2)_2\text{(l)}$
- (i) From the equation, identify gangue, flux and slag (3 marks)
 - (ii) Explain any two advantages of slug in Iron extraction (2 marks)
- b) Describe any two methods of preparing metal clusters (6 marks)
- c) Distinguish between calcination and roasting (2 marks)
- d) What are the five major steps in metallurgy? (5 marks)
- e) with examples explain what you understand by each of the following terms:
- (i) reductive elimination (2 marks)
 - (ii) migratory insertion (2 marks)
- f) Explain the following terminologies as used in catalysis (4 marks)

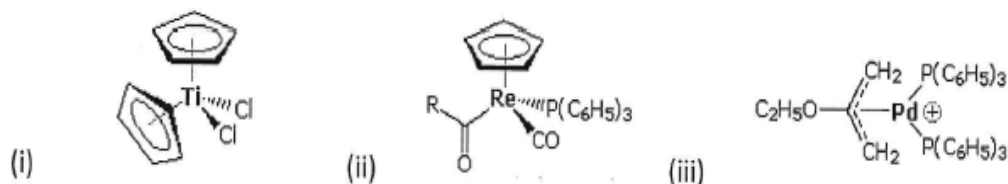
(i) Selectivity

(ii) Activity

g) Explain the roles played by transition metal ions in biological system (4 marks)

QUESTION TWO (20 MARKS)

a) Determine the oxidation state and the valence electron count for Ti, Re and Pd in the following organometallic compounds (6 marks)



b) Study the table below and then answer questions that follows

Compound	ν_{CO} (cm^{-1})
CO	2143
$[\text{CpFe}(\text{CO})_2]_2$	1926, 1751
$\text{Fe}(\text{CO})_6^{2+}$	2204
$\text{Fe}(\text{CO})_5$	2022, 2000

- (i) Explain why the carbonyl stretching frequency of $\text{Fe}(\text{CO})_6^{2+}$ appear in higher wavenumbers than that of $\text{Fe}(\text{CO})_5$ (4 marks)
- (ii) Which the two $\text{Fe}(\text{CO})_5$ or would be more stable $\text{Fe}(\text{CO})_6^{2+}$? Explain (2 marks)
- (iii) If you are using Infrared spectroscopy to monitor the reaction between and iodine to form $\text{CpFe}(\text{CO})_2\text{I}$, how would you tell that the reaction has actually occurred? (2 marks)
- c) Give three reasons why metal-ligand coordination complexes such as $[\text{Pd}(\text{pPh}_3)_4]$ are often more useful than elemental metals for organometallic catalysis (6 marks)

QUESTION THREE (20 MARKS)

- a) Account for the fact that most of important ores exist in form of oxides, sulphides, carbonates, halides or silicates. (2 marks)
- b) Name two ores from which each of the following metals can be extracted
- (i) Iron (2 marks)
 - (ii) Titanium (2 marks)
- c) Explain why Iron is not extracted from Pyrite although pyrite is abundant in earth crust. (2 marks)
- d) Highlight four properties of Iron that make it the most utilized transition metal. (4 marks)
- e) Describe the two principal methods for the synthesis of monometallic metal carbonyls. Provide equations to illustrate main reactions (8 marks)

QUESTION FOUR (20 MARKS)

- a) Briefly describe the mechanism involved in polymerization of an alkene over the Ziegler-Natta catalyst $TiCl_4/AlEt_3$ (7 marks)
- b) Using suitable examples, discuss briefly any three methods of synthesizing organometallic compounds (8 marks)
- c) What are the indicators of Biologically Important Elements? (5 marks)

QUESTION FIVE (20 MARKS)

- a) Explain any four methods of ore concentration. (16 marks)
- b) State two roles played ligands in biological system (4 marks)